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BASANITE FROM CRAWFORD COUNTY, INDIANA.

BY E. GOLDSMITH.

During a recent visit to the Wyandotte Cave, southern Indiana, I observed in one of the larger chambers, two sharply defined horizontal black veins in one of the vertical walls of light colored carboniferous limestone. The lower vein measured about one and a quarter inch in thickness, and, about fourteen inches above it, was the second vein of three inches in thickness. From a distance, by the dim light of a stearine candle, the veins appeared like coal; the touch, however, revealed a hard rock of a silicious nature, which the guide said was called chert.

Examination revealed an amorphous, very fine-grained rock having a smooth conchoidal fracture; the irregular edges are sharp and hard, so much so that they scratch glass, its hardness being equal to quartz; its luster is subresinous on a fresh fracture, becoming dull on exposure; the color is smoky-gray in mass, less so when thinning down; it is opaque except on thin edges where it is subtranslucent; it furnishes no streak; the rock is not splintery; it gives sparks with a steel. If heated suddenly it will decrepitate; a gentle heat, gradually increased, causes the smoky hue to disappear, the specimen becoming grayish-white. It is known that such rocks contain carbon, and the one under consideration contains also some water as was seen when it is heated in a tube closed at the end.

Analysis, gave the following result:

Silica	93·66 per cent.
Iron and alumina	3·10 per cent.
Water	1·34 per cent.
Carbon	0·28 per cent.

Fluorine and sodium not determined; Chlorine hardly a trace. Sp. gr.=2·605. From its general character I believe this so called Chert to be the touchstone of the assayers, otherwise called Lydian stone or Basanite.[1]

A thin section appears when magnified with a low power as regular successive layers, or striae, differing, however, from those of crystals. These striae indicate the probable existence of great pressure, since it seems to have once been colloidal silica. The distances between these layers are approximately 0·023 millimeter. The layers when magnified 220 times present a series of irregular waves in which the ridges seem to be indicated by granules of oxide of iron and particles of amorphous carbon. Intermingled are found inclusions of isometric forms: cubes, dodecahedrons and also indications of a few octahedrons, some perfectly black but the greater number transparent and colorless. The opaque black microlites seem to be magnetite and the transparent ones probably carbon. Some of these latter contain specks of amorphous carbon as inclusions. The section in balsam gave at some points a strong reflection by surface illumination. The forms, however, were not well defined. Another section was etched with HF. The etching showed under the lens some cubical crystals with sharp edges and solid angles and a large number of hollows, quadrangular and hexangular in shape, from which the microlites had probably been removed by the washing, sufficient indications being left for the recognition of those interesting small bodies. The thin section from which Fig. 1 was drawn was subjected to a gradually increasing heat on a small platinum dish over the Bunsen burner until the object was red-hot. The residue was subjected to this heat for three hours when the blow-pipe flame

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[1] Dana, Descriptive Mineralogy, p. 195.

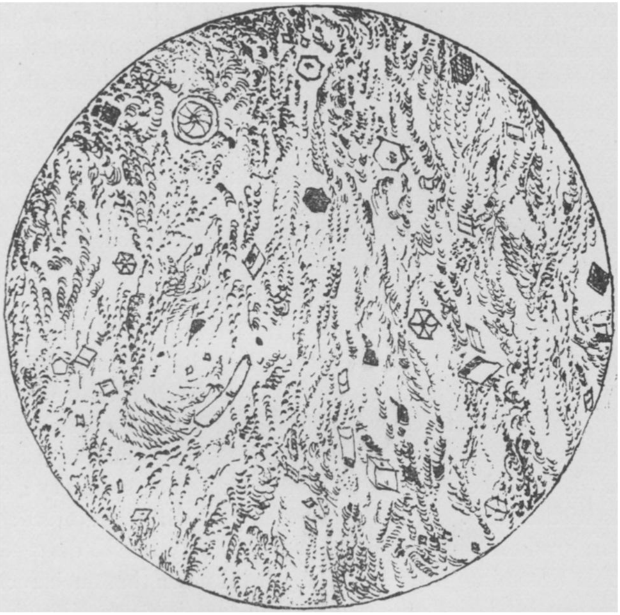
Fig. 1.

was directed upon it to bring the heat to greater intensity. The result was that the section became nearly white. It was then reimbedded in balsam to determine the change which had taken place.

Viewed under ordinary light with a microscope, nearly all the transparent crystals had disappeared, that is to say, the forms were black, and with the proper management of the light it became evident that hollow spaces now occurred where formerly transparent crystals existed. The matrices were lined more or less with a very fine black powder which was, to all appearances, charcoal. This darkening was invariably produced wherever the microlites had but one facet before the heating. Where the silica surrounded the crystal it appeared as if the heat and air had no access and, in consequence, they were not affected, though such cases were but few in number. Some of the hollow spaces were seen by oblique light to be lined with red oxide of iron. These were the locations of the oxidized magnetite where the red powder was left intact. The hollow angular spaces may also be recognized by allowing the light to pass through the polarizer without the analyzer. Under this treatment, especially when the spaces stand squarely to the section, the burnt-out angular matrices are well defined.

The character of these microlites was determined by the application of intense heat. A silicate would not be affected in like manner. It may not be amiss to note the fact that larger carbon crystals have been observed which hold inclusions of amorphous carbon similar to those noticed in the section of basanite referred to.

Some spherical white masses formed by the heating of the section were probably due to a volatile matter which is known to form part of the composition of basanite; they resemble those frequently observed on heating minerals containing fluorine.

The acid affects the material of the plate etched with hydrofluoric acid very irregularly, and, since the rock seems to be a mixture of chalcedony and amorphous silica, a peculiar reaction occurs with polarized-light. While the chalcedony indicated phenomena of interference, the amorphous silica permitted the polarized light to pass. This is especially the case when Klein's quartz plate is interposed. The amorphous silica then appears green, when the Nicols are crossed, and the chalcedony orange-colored. On turning the analyzer 90° the colors are reversed. The hydrofluoric acid seems to affect the amorphous silica more than the chalcedony, as the latter projected irregularly over the etched surface. These projecting particles when properly manipulated reflect the light in a singular way. The reflection of the ray is such as to form a tail from the shining surface of the particles, comet-like, the end of the tail having sometimes a whirling motion with colored fringes. Occasionally, when a group of those particles is under focus, Fig. 2, the motions proceed in different directions producing a peculiarly lively effect. On the introduction of a Bertrand lens, a rosette, Fig. 3, was produced widely differing from the comet-like reflection. This rosette represents a circular form having a cone whose base has about the diameter of half the whole figure and its height slightly greater. From the foot of the cone issue delicate filamentous rays of great regularity and so brilliant that it is difficult to represent it in black and white.

Fig. 2.

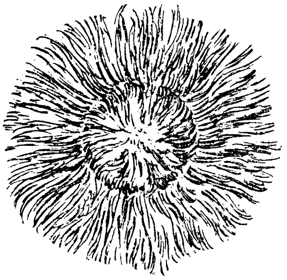
Fig. 3.

When the comet-like tail is not observed, a hollow cone is seen under the Bertrand lens, having but few rays on its base. Both phenomena are new to me in connection with micro-mineralogy. In optics the caustic plane has precisely such an appearance and in its revolution gives, necessarily, a hollow cone. From this we may infer that the comet-like tails described above are probably continuous in their whirling motion, even when they are not in a correct position to allow this to be seen under the microscope.

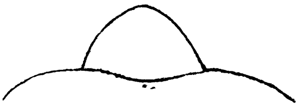
Fig. 4.

It may be assumed that the black hexagonal plates which remain dark between the crossed Nicols may be truly hexagonal crystals, and the darkness is due to the position of the axis; but, since they are not affected by the convergent polarized rays, the form cannot belong to that system. Neither do any of the transparent crystals respond to a like treatment. Sev-

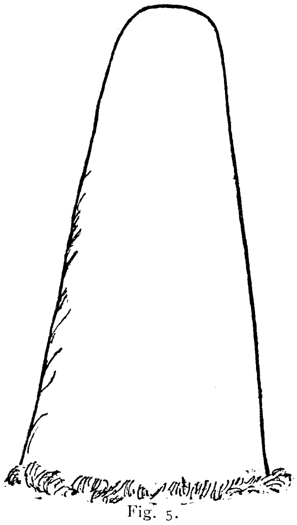
Fig. 5.

eral dozen illustrations of both phenomena were examined with the same result. That the dark forms are magnetite is rendered highly probable by the production of iron oxide by heating. On the other hand, the small transparent microlites may not be carbon, because on attempting to isolate them by hydrofluoric acid the resulting forms obtained were not distinct enough to be recognized as such, as one should expect, being granules instead of well defined crystals. On heating to redness they burned away leaving but a trace of what seems to be silica. The isolation of the supposed crystals of carbon would be proof of their identity ; the result, however, being unsatisfactory, the subject is an open question for further inquiry. Had the isolated portion been amorphous carbon, dark-colored fragments would have been seen, but such was not the case, on the contrary the rounded and elongated forms seem to refract light strongly. It may be that the exceedingly small crystals could not stand the treatment without losing their sharp edges and solid angles, thus becoming unrecognizable. The fact that the burnt-out matrices were lined with amorphous carbon after burning, points in that direction, since it is well known that the diamond when strongly heated in a vessel will lose its transparency and will either take the form of graphite or charcoal. It may be assumed that the transparent crystals are a salt with an organic acid, thus explaining the amorphous carbon after the incineration. In this case, however, the material with which the assumed organic acid was combined would remain in the matrices besides the amorphous carbon, but nothing was seen except the black powder. Furthermore, hydrofluoric acid would affect such a salt with comparative ease and leave no carbon in the residue as stated above.

I call the crystallized part of the basanite, chalcedony and not quartz because of certain indications of its fibrous structure in the circular form, showing a dark brush-like cross between the crossed Nicols, which meet in the center. If the section is rotated the cross does not change its position ; but, if the analyzer is turned to 45° the brushes move about 22½° and appear of an indigo-blue color. If the Nicols are parallel, the brushes follow but 45° in each quadrant and appear blue ; turning the analyzer 45° more the brushes move along to about 67½° and assume the indigo-blue tint again ; finally, when the moving of the analyzer is completed in the second quadrant, the dark, brush-like cross reappears. When, therefore, the analyzer had been revolved 180°, the brush-like cross followed only 90°. As stated above the dark cross met in the center ; but, on turning the analyzer when the brushes became colored, a circular space was produced in the center having a yellow color which did not change to any other.

Since no circular rings occurred and the central part of the concentric and fibrous structure of this part of the plate did not change in color when rotated, it is evident that this variety of quartz, called chalcedony, behaves in a widely different manner from quartz proper. I have not found this peculiar optical behavior described and think it to be of sufficient interest to put on record.

EXPLANATION OF THE FIGURES.

Figure 1 represents a thin section of Basanite magnified 220 times showing the transparent crystals of carbon and the dark opaque magnetite.

Figure 2 shows a group of strongly reflecting points as seen by surface illumination.

Figure 3 the rosette produced therefrom by introducing the Betrand lens.

Figure 4 a contour of figure 3 cut vertically.

Figure 5 indicates the cone produced from reflecting points having no comet-like tails.